

What is claimed is:

1. A network apparatus that interconnects two or more (= N) basic elements each having the capability to function as one computer, comprising:

N switch device groups each having N switch  
5 devices, each of said N switch device groups being electrically configured such that one of said N switch devices is connected to one of said basic elements without duplicity, i.e., without selecting the same basic  
10 element twice and first to Nth switch devices are connected in series in the order that a first switch device is connected directly to a basic element, a second switch device is connected to said first switch device, a third switch device is connected to said second switch device and so on up to a final Nth switch device, said  
15 Nth switch device being connected to a (N-1)th switch device, and

N loop lines, each being configured by connecting one switch device in each of N switch device groups in a loop without duplication, i.e., without  
20 selecting the same device twice.

2. A network apparatus according to claim 1 wherein, if a number  $n$  (where  $1 \leq n \leq N$ ) denotes an nth switch device, said loop line connects a switch device of each switch device group in a loop such that the switch

5 device numbers increase one by one with progression around the loop line in either a clockwise or counter-clockwise direction and such that the switch device of switch device number N is connected to the switch device of switch device number 1.

3. A network apparatus according to claim 2 wherein said one of said basic elements and said first switch device, i.e., switch device 1 are bidirectionally connected for input and output of data.

4. A network apparatus according to claim 3 wherein each of the switch devices that constitute said switch device group is unidirectionally connected for one-way transfer of data toward said first switch device.

5. A network apparatus according to claim 4 wherein connections between each of the switch devices that make up said loop lines are bidirectional connections for data transfer.

6. A network apparatus according to claim 5 wherein each of the switch devices that constitute each switch device group comprises:

a first port exclusively for receiving data  
5 attached with destination information received from an

adjacent switch device in the same switch device group;

a second port exclusively for receiving data attached with destination information received from a basic element only when said switch device is directly  
10 connected to that basic element;

a third port and a fifth port for both input and output connected to said loop line;

a first and a second decoder for judging whether data attached with destination information  
15 received from said third port or fifth port, respectively, are communication addressed to a basic element connected to the switch device group concerned or communication addressed to a basic element connected to another switch device group;

a switch unit for, in a case in which it is judged by said first or second decoders that data attached with destination information are addressed to said basic element connected to the switch device group concerned, selecting either that data addressed to the  
20 basic element concerned or data attached with destination information that have been received from said first port;

first and second repeaters for, in a case in which it is judged by said first and second decoders, respectively, that data attached with destination  
30 information are not addressed to said basic element connected to the switch device group concerned, repeating

that data attached with destination information;

first and second selectors for selecting one  
of: data attached with destination information that have  
35 been received from said first and second repeaters and  
data attached with destination information that are  
received from said second port, to send the selected data  
to said fifth port or third port, respectively; and

a fourth port exclusively for delivering data  
40 attached with destination information selected by said  
switch unit to a switch device adjacent in the direction  
of the basic element in the switch device group concerned  
or to the basic element.

7. A network apparatus according to claim 6  
wherein first and second selectors of the switch device  
directly connected to said basic element make a fixed  
selection of only data attached with destination  
5 information that are received from said second port.

8. A network apparatus according to claim 6  
wherein first and second selectors of the switch device  
connected to an adjacent switch device in the same switch  
device group by way of said fourth port make a fixed  
5 selection of only data attached with destination  
information that have been sent from said first and  
second repeaters, respectively.

9. A network apparatus that interconnects two or more pairs (= N pairs) of basic elements, each basic element having the capability to function as one computer, comprising:

5                   N switch device groups each having N switch devices, each of said N switch device groups being electrically configured such that: one of said N switch devices is connected to one pair of said basic elements without duplicity, i.e., without selecting the same basic  
10 element twice; and first to Nth switch devices are connected in series in the order that a first switch device is connected directly to a basic element, a second switch device is connected to said first switch device, a third switch device is connected to said second switch  
15 device and so on up to a final Nth switch device, said Nth switch device being connected to a (N-1)th switch device, and

                  N loop transmission paths, each being configured by connecting one switch device in each of N  
20 switch device groups in a loop without duplication, i.e., without selecting the same device twice.

10. A network apparatus according to claim 9 wherein, if a number n (where  $1 \leq n \leq N$ ) denotes an nth switch device, said loop transmission path connects a

switch device of each switch device group in a loop such  
5 that the switch device numbers increase one by one with  
progression around the loop transmission path in either a  
clockwise or counter-clockwise direction and such that  
the switch device of switch device number N is connected  
to the switch device of switch device number 1; said one  
10 pair of said basic elements and said first switch device,  
i.e., switch device 1 are bidirectionally connected for  
input and output of data; and each of the switch devices  
that constitute said switch device group is  
unidirectionally connected for one-way transfer of data  
15 toward said first switch device.

11. A network apparatus according to claim 10  
wherein each of said N loop transmission paths is  
composed of two loop lines, whereby the two basic  
elements connected to the same switch device group  
5 communicate with basic elements connected to other switch  
device groups through different loop lines of the same  
loop transmission path.

12. A network apparatus according to claim 11  
wherein each switch device comprises a first and second  
basic switch circuit, and each of the basic switch  
circuits comprises:  
5 a first port exclusively for receiving data

attached with destination information that are sent from  
an adjacent switch device in the same switch device  
group;

10 a second port exclusively for receiving data  
attached with destination information that are sent from  
a first or a second basic element of said pair of basic  
elements only if that switch device is directly connected  
to said pair of basic elements;

15 a third port and a fifth port that are  
connected to said loop transmission path;

a first decoder for judging whether data  
attached with destination information that have been  
received from said third port are communication addressed  
to a basic element that is connected to the switch device  
20 group concerned or communication addressed to a basic  
element that is connected to another switch device group;

a switch unit;

a fourth port for supplying the output of said  
switch unit to a basic element that is connected to the  
25 switch device group concerned; and

a repeater for, in a case in which it is  
judged by said first decoder that data attached with  
destination information are communication addressed to a  
basic element that is connected to said other switch  
30 device group, repeating that data attached with  
destination information;

said first and second basic switch circuits  
each further including a selector and a second decoder;  
wherein:

35           the second decoder of the first basic switch  
circuit receives, by way of the second port, data  
attached with destination information from the first  
basic element that is connected to the second port of the  
first basic switch circuit and judges whether the data  
40   attached with destination information are communication  
addressed to the second basic element or communication  
addressed to the basic element that is connected to  
another switch device group by way of a loop line;

          the second decoder of the second basic switch  
45   circuit receives, by way of the second port, data  
attached with destination information from the second  
basic element that is connected to the second port of the  
second basic switch circuit and judges whether the data  
attached with destination information is communication  
50   addressed to the first basic element or communication  
addressed to the basic element that is connected another  
switch device group by way of a loop line;

          the switch unit of the first basic switch  
circuit receives:

55           data attached with destination information  
that have been received from the first port of the first  
basic switch circuit; data attached with destination



information that have been received from the third port  
of the first basic switch circuit when the first decoder  
60 of the first basic switch circuit judges that these data  
attached with destination information are addressed to  
the first basic element; and data attached with  
destination information that have been received from the  
second port of the second basic switch circuit when the  
65 second decoder of the second basic switch circuit judges  
that these data attached with destination information are  
communication addressed to the first basic element; and  
selects any of these data attached with destination  
information, and supplies the selected data to the fourth  
70 port of the first basic switch circuit;

the switch unit of the second basic switch  
circuit receives:

data attached with destination information  
that have been received from the first port of the second  
75 basic switch circuit; data attached with destination  
information that have been received from the third port  
of the second basic switch circuit when the first decoder  
of the second basic switch circuit judges that these data  
attached with destination information are addressed to  
80 second basic element; and data attached with destination  
information that have been received from the second port  
of the first basic switch circuit when the second decoder  
of the first basic switch circuit judges that these data

attached with destination information are communication  
85 addressed to the second basic element; and selects any of  
these data attached with destination information, and  
supplies the selected data to the fourth port of the  
second basic switch circuit;

the selector of the first basic switch circuit  
90 selects one of:

data attached with destination information  
that have been received from the second port of the first  
basic switch circuit when the second decoder of the first  
basic switch circuit judges that these data attached with  
95 destination information are communication addressed to  
the basic element connected to another switch device  
group; and output of the repeater of the first basic  
switch circuit; and supplies the selected data to the  
fifth port of the first basic switch circuit; and

100 the selector of the second basic switch  
circuit selects one of:

data attached with destination information  
that have been received from the second port of the  
second basic switch circuit when the second decoder of  
105 the second basic switch circuit judges that these data  
attached with destination information are communication  
addressed to the basic element connected to another  
switch device group; and output of the repeater of the  
second basic switch circuit;

110 and supplies the selected data to the fifth  
port of the second basic switch circuit.

13. A network apparatus according to claim 10  
wherein each loop transmission path of said N loop  
transmission paths is composed of one loop line, and two  
basic elements that are connected to the same switch  
5 device group communicate with a basic element connected  
to another switch device group through the same loop line.

14. A network apparatus according to claim 13  
wherein each switch device comprises:

first port 1-1 for the first basic element and  
first port 1-2 for the second basic element, both ports  
5 exclusively for receiving data attached with destination  
information received from an adjacent switch device in  
the switch device group concerned;

second ports 2-1 and 2-2 exclusively for  
receiving data attached with destination information that  
10 are sent from the first or second basic element,  
respectively, only when that switch device is connected  
directly to the basic elements;

a third port and a fifth port connected to an  
adjacent switch device by way of a loop line;

15 a first decoder for judging whether data  
attached with destination information that have been

received from said third port are communication addressed to the first basic element, communication addressed to the second basic element, or communication addressed to a  
20 basic element that is connected to another switch device group;

a repeater for repeating data attached with destination information when the first decoder has judged that the data attached with destination information are  
25 communication addressed to a basic element connected to another switch device group;

a second decoder for judging whether data attached with destination information that have been received from second port 2-1 are communication addressed to  
30 to the second basic element or communication addressed to a basic element that is connected to another switch device group;

a third decoder for judging whether data attached with destination information that have been  
35 received from second port 2-2 are communication addressed to the first basic element or communication addressed to a basic element that is connected to another switch device group;

a first switch for selecting one of data  
40 attached with destination information that have been judged by the second decoder to be communication addressed to a basic element that is connected to another

switch device group and data attached with destination  
information that have been judged by the third decoder to  
45 be communication addressed to a basic element that is  
connected to another switch device group;

a selector for selecting one of: data attached  
with destination information that have been selected by  
said first switch and data attached with destination  
50 information that have been supplied from said repeater  
and delivering the selected data by way of the fifth  
port;

a second switch for selecting one of: data  
attached with destination information that have been  
55 received from first port 1-1; data attached with  
destination information that have been determined by the  
first decoder to be communication addressed to the first  
basic element; and data attached with destination  
information that have been judged by the second decoder  
60 4-2 to be communication addressed to the first basic  
element;

a third switch for selecting one of: data  
attached with destination information that have been  
received from first port 1-2; data attached with  
65 destination information that have been judged by the  
first decoder to be communication addressed to the second  
basic element; and data attached with destination  
information that have been judged by the second decoder

to be communication addressed to the second basic  
70 element;

fourth port 4-1 for delivering data attached  
with destination information that have been selected by  
said second switch to another switch device in the same  
switch device group or to the first basic element; and

75 fourth port 4-2 for delivering data attached  
with destination information that have been selected by  
said third switch to another switch device in the same  
switch device group or to the second basic element.